Random Graphs and Stochastic Geometry in Networks

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Timetable: 20 hrs. Class meets every Tuesday and Thursday from 2:30 to 4:30. First lecture on Tuesday, June 10-th, 2014. Room 318 DEI/G (3-rd floor, Dept. of Information Engineering, via Gradenigo Building).

Course requirements: Advanced calculus, and probability theory and random processes

Examination and grading: A project assignment for students in groups of 2 requiring about 20 hours of work.

Aim: To provide graduate students with some basic concepts of random graphs and stochastic geometry and illustrate their applications to relevant engineering problems involving networks, such as multiagent control networks, wireless communication networks etc.

Course contents:

- *Introduction to random graphs*: basic models and properties, random regular graphs, giant component, connectivity, degree sequence (2 lectures)
- *Basic Percolation Theory*: Tree percolation, lattice bond percolation (1 lecture)
- *Small world and scale free networks* (1 lecture)
- *Consensus and Gossip algorithms*: a short survey for distributed averaging, consensus over random switching graphs, consensus and gossip algorithms for distributed estimation (2 lectures)
- *Connectivity and capacity in wireless multihop networks* (1 lecture)
- *Stochastic Geometry and its applications*: Basic Point Process theory and properties, hard-core and Gibbs processes, Applications to characterizing interference and outage in networks (2 lecture)
- *Applications of Stochastic Geometry to wireless networks* (1 lecture)

References:

[1] Bella Bollobas, Random Graphs, Second Edition, Cambridge Studies in Advanced Mathematics, Cambridge University Press, UK, 2001.
[2] M. Haenggi, Stochastic Geometry for Wireless Networks, Cambridge University Press, New York, 2013.
[3] M. Grossglauser and P. Thiran, "Networks out of Control: Models and Methods for Random networks", Lecture notes, EPFL, 2012.
[4] M. Franceschetti and R. Meester, Random Networks for Communication: From Statistical Physics to Information Systems, Cambridge University Press, UK, 2007.

Various articles and papers will be referenced during the course for further reading.